DISC RECLINER WITH DUAL CAMS

FIELD OF THE INVENTION

[0001] The present invention relates to recliner mechanisms, and more particularly, to a disc recliner for use with a seat assembly.

BACKGROUND OF THE INVENTION

[0002] Rotary recliner mechanisms generally include of a first rotary member having a plurality of teeth and a second rotary member including one or more pawls adapted to lockingly engage the teeth to couple the rotary members to one another. Typically, one rotary member is mounted to a quadrant for attachment to a seat back and the second rotary member is mounted to a base plate for attachment to a seat base. The rotary recliner mechanisms are operable to lock the rotary member connected to the seat back to restrict its rotation, or to release the rotary member connected to the seat back to allow it to rotate and to enable the seat back to recline.

[0003] The rotary recliner mechanism is selectively locked or released by manipulating the one or more pawls, which are mounted for rotation between an engaged position where the teeth of the pawl and the teeth of the rotary member connected to the seat base mesh, and a disengaged position where the pawl retracts and no longer meshes with the teeth of the rotary member connected to the seat base. Locking rotary recliner mechanisms also may include a device, such as a spring, for releasably urging the pawl from the

disengaged to the engaged position so that the default position for the mechanism is a locked condition. Further, the rotary recliner typically includes an activating mechanism that moves the pawl from the engaged position to the disengaged position.

[0004] In reclining seats, the seat back functions as an extremely long lever arm against which various forces are applied. The locking rotary recliner mechanism in a vehicle seat is relatively small compared to the length of the reclining seat back, and vehicle vibration or movement of an occupant may impose various forces upon that lever during use. These forces impose a large moment about the rotary member connected to the seat back when applied along such a lengthy lever arm. If the forces are sufficient, or the rotary recliner mechanism is poorly designed, these forces can overcome the capability of the rotary recliner mechanism to anchor the seat back.

[0005] In addition, any imperfection in the components of the pivot mechanisms, such as play or backlash between the engaging teeth or tolerances between the mechanism components, may allow the rotary member connected to the seat back to move a miniscule amount even when the mechanism is locked. Such small movements are magnified by the length of the lever arm and become noticeable at the upper end of the seat. For example, a seat back of an unoccupied seat may tend to oscillate when the vehicle encounters rough road conditions. Because the motion of the seat back is amplified by the length of the seat back frame, the vibration of the seat back can be relatively large. This magnified play in locking pivot mechanisms has been termed "chucking" and

refers to any imperfections or play in the mechanism components that allow movement of the rotary member and attached seat back while the mechanism is in a locked condition.

[0006] One technique employed to reduce chucking is to form the components of the pivot mechanism with exceedingly close tolerances. Such techniques reduce play in the mechanism, and thus reduce chucking, but manufacturing to such close tolerance is expensive and difficult to achieve. Further, close tolerances may bind the components of the system and prevent smooth operation.

[0007] Therefore, a recliner mechanism that is operable to lock a seat back relative to a seat bottom in a plurality of positions while preventing chucking is desirable in the industry. Furthermore, a recliner mechanism that prevents chucking without requiring extensive and expensive manufacturing techniques is also desirable.

SUMMARY OF THE INVENTION

[0008] Accordingly, a recliner assembly is provided and includes a first housing plate, a second housing plate, and a pawl. The pawl is movable between a locked position engaging the second housing plate to prohibit rotation of the second housing plate relative to the first housing plate and an unlocked position disengaging the second housing plate to enable rotation of the second housing plate relative to the first housing plate. A locking cam is rotatably supported by the first housing plate and is operable to engage the pawl to urge

the pawl into the locked position. In addition, a main cam is provided and is rotatably supported by the first housing plate to selectively rotate the locking cam into engagement with the pawl to urge the pawl into the locked position.

[0009] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0011] FIG. 1 is a perspective view of a recliner mechanism in accordance with the principals of the present invention;

[0012] FIG. 2A is an exploded view of the recliner mechanism of FIG. 1;

[0013] FIG. 2B is a more detailed view of particular components of FIG. 2A.

[0014] FIG. 3 is a plan view of the recliner mechanism of FIG. 1 with part of a housing removed to show the internal workings of the recliner mechanism in a locked position;

[0015] FIG. 4 is a plan view of the recliner mechanism of FIG. 1 with part of a housing removed to show the internal workings of the recliner mechanism in a locked position;

[0016] FIG. 5 is a plan view of the recliner mechanism of FIG. 1 with part of a housing removed to show a more detailed view of the internal workings of the recliner mechanism in an unlocked position;

[0017] FIG. 6 is a plan view of the recliner mechanism of FIG. 1 with part of a housing removed to show the internal workings of the recliner mechanism in an unlocked position;

[0018] FIG. 7 is a plan view of the recliner mechanism of FIG. 1 with part of a housing removed to show the internal workings of the recliner mechanism in a locked position; and

[0019] FIG. 8 is a plan view of the recliner mechanism of FIG. 1 incorporated into a seat assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] The following description of the preferred embodiment is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0021] With reference to the figures, a recliner mechanism 10 is provided an includes a housing 12, a sector plate 14, and a lock mechanism 16. The sector plate 14 and lock mechanism 16 are supported by the housing 12, whereby the lock mechanism 16 is operable to selectively lock the sector plate

14 in a plurality of positions relative to the housing 12, as will be described further below.

[0022] The housing 12 includes an inner housing plate 18 and an outer housing plate 20 fixedly attached by a pair of rivets 22. The rivets 22 include a central cylindrical section 24 and flanking cylindrical sections 26. The flanking cylindrical sections 26 are fixedly received by attachment apertures 28 formed in the inner and outer housing plates 18, 20 and serve to fixedly attach the inner housing plate 18 to the outer housing plate 20. In this manner, the center cylindrical section 24 is disposed between the inner and outer plates 18, 20 and serves to set the relative spacing therebetween.

[0023] The inner housing plate 18 includes a central aperture 30, a spring aperture 32, and a pair of slots 34. The outer housing plate 20 similarly includes a central aperture 36, a spring aperture 38, and a pair of slots 40, whereby the central aperture 36, spring aperture 38, and slots 40 are coaxially aligned with the respective central aperture 30, spring aperture 32, and slots 34 of the inner housing plate 20 once the inner housing plate 18 is fixedly attached to the outer housing plate 20 by rivets 22.

[0024] The outer housing plate 20 further includes a raised flange 42 and an arm 44, whereby the raised flange 42 is operable to engage the sector plate 14 and the arm 44 is operable to attach the outer housing plate 20 to an external structure, as will be discussed further below. The raised flange 42 comprises a substantially circular shape and includes an engagement surface 43 for interaction with the sector plate 14. Furthermore, the flange 42 generally

encircles attachment apertures 28, central aperture 30, spring aperture 32, and slots 34, as best shown in FIGS. 2A and 2B. The arm 44 extends from the outer housing plate 20 and includes a pair of attachment apertures 46 for interaction with an external structure, as best shown in FIGS. 2 and 8.

[0025] The sector plate 14 is rotatably supported between the inner and outer housing plates 18, 20 and includes a flange 48, a central aperture 50, and an arm 52. The flange 48 generally encircles the central aperture 50 and includes a recess 54 having an engagement surface 56 operable to rotatably receive the engagement surface 43 of the outer housing plate 20. In this manner, rotation of the sector plate 14 relative to the inner and outer housing plates 18, 20 is governed by the interaction between the engagement surface 43 of flange 42 and engagement surface 56 of flange 48.

[0026] The central aperture 50 is coaxially aligned with the flange 48 and includes a plurality of teeth 58 formed on an inner surface thereof. The arm 52 extends from the central aperture 50 an includes a plurality of attachment apertures 60. The attachment apertures 60 are operable to fixedly attach the sector plate 14 to an external structure, as will be described in greater detail below.

[0027] The locking mechanism 16 is operable to selectively lock the sector plate 14 in a plurality of radial positions relative to the inner and outer housing plates 18, 20 and includes a pair of pawls 62, a pair of locking cams 64, and a main cam 66.

[0028] The pawls 62 each include a first arm 68, a second arm 70, and a plurality of teeth 72 formed on an arcuate surface 74. The first arm 68 includes a reaction surface 76 formed at an angle Θ relative to a top surface 78 of the first arm 68, whereby Θ is substantially between 14-22°. The angular relationship between the reaction surface 76 and the top surface 78 is further depicted in FIG. 5, whereby the planar reaction surface 76 and planar top surface 78 have each been extended to more clearly depict the angular relationship therebetween.

[0029] The second arm 70 similarly includes a reaction surface 80 formed at an angle Θ relative to a top surface 82, whereby Θ is substantially between 14-22°. In this regard, the reaction surface 76 of the first arm 68 is formed at a generally equivalent angle to that of the reaction surface 80 of the second arm 70, as best represented in FIG. 5. In addition, the second arm 70 further includes an attachment aperture 84 formed therethrough. The attachment aperture fixedly receives a pin 86, whereby the pin 86 includes a reaction surface 88 formed along its length for interaction with a release mechanism, as will be described in more detail below.

[0030] Each pawl 62 further includes a recess 90 having a reaction surface 92 formed between the first and second arms 68, 70 for interaction with a respective post 94. The posts 94 are fixedly received by slots 34 and 40 of the inner and outer housing plates 18, 20, respectively, and serve to define a range of motion for each pawl 62 and to further set the relative positional relationship between the inner and outer housing plates 18, 20. Specifically, each post 94 includes a pair of planar side walls 96 which are slidably received by the reaction

surface 92 of recess 90. In this manner, the posts 94 restrict lateral movement of the pawl 62 relative to the inner and outer housing plates 18, 20 and only provide for up and down movement of the pawl 62 between a locked position and an unlocked position.

[0031] As will be described in greater detail below, the locked position is achieved when the pawls 62 are moved along the posts 94 to a point when teeth 72 are meshed with teeth 58 of the sector plate 14. At this point, the sector plate 14 is restricted from rotating relative to the inner and outer plates 18, 20 due to the engagement between the pawls 14 and central bore 50 of the sector plate 14. Conversely, the unlocked position is achieved when the pawls 62 are traversed along the posts 94 to a point when teeth 72 of the pawls 62 are released from engagement with teeth 58 of the sector plate 14. As can be appreciated, when the pawls 62 are disengaged from the sector plate 14, the sector plate 14 is free to rotate relative to the inner and outer housing plates 18, 20.

[0032] The locking cams 64 include a central attachment aperture 98 and an arm 100 extending from the central attachment aperture 98, as best shown in FIGS. 2A AND 2B. Each central attachment aperture 98 rotatably receives the central cylindrical section 24 of rivet 22 to allow the locking cams 64 to freely rotate relative to the inner and outer housing plates 18, 20. The arm 100 includes a first reaction surface 102 and a second reaction surface 104. The first reaction surface 102 is formed proximate to, and facing reaction surface 76 of pawl 62. The reaction surface 102 is formed at an angular relationship with the

locking cam 64 so as to matingly engage the reaction surface 76 of the pawl 76, as best shown in FIGS. 4 and 5. The second reaction surface 104 is formed opposite from the first reaction surface 102 and generally faces the main cam 66.

[0033] The main cam 66 includes a main cylindrical body 106 and a first and second arm 108, 110 formed integrally therewith. The main cylindrical body 106 includes a bore 112 formed therethrough having a plurality of flats 114. The flats 114 matingly receive a main pivot 116 to rotatably support the main cam 66 between the first and second housing plate 18, 20. More particularly, the main pivot 116 includes a keyed cylindrical section 118 for mating engagement with flats 114 such that the main cam 66 is fixed for rotation with the main pivot 116. In addition, the main pivot 116 includes a cylindrical section 120 and a square section 122 disposed on opposite sides of keyed section 118 and a cylindrical section 124 having a spring seat 126, as best shown in FIGS. 2A AND 2B. The main pivot 116 is rotatably received through central apertures 30, 36 of the inner and outer housing plates 18, 20, respectively, such that cylindrical section 124 and spring seat 126 extend from an outer surface of inner plate 18, as best shown in FIG. 1.

[0034] The first arm 108 includes a first reaction surface 128 and a second reaction surface 130. The first reaction surface 128 is in abutting engagement with reaction surface 104 of the locking cam 64 when the pawl 62 and locking cam 64 are in the locked position, as best shown in FIGS. 4 and 5. The second reaction surface 130 is spaced apart from the second arm 70 of the pawl 62 a predetermined distance such that a gap 132 is created therebetween.

In this manner, the main cam 66 is not in contact with the pawl 62 when the pawl 62 is in the locked position. Providing a gap 132 between the main cam 66 and the pawl 62 when the pawl 62 is in the locked position allows the main load path or lock path to extend between the main cam 66, lock cam 64, and pawl 62, as best shown in FIG. 5. In other words, the pawl 62 is held in engagement with the sector plate 14 due to the interaction between the first reaction surface 128 of the main cam 66, lock cam 64, and pawl 62. As will be described further below, such a relationship provides the recliner mechanism 10 with a more desirable operation as less force is required to toggle the recliner mechanism 10 between the locked and unlocked positions.

[0035] The second arm 110 similarly includes a first engagement surface 134 and a second engagement surface 136, as best shown in FIGS. 2A AND 2B. The first engagement surface 134 is in abutting engagement with the first arm 68 of the pawl 62 while the second engagement surface 136 is spaced apart from the second arm 70 of the pawl 62, thereby creating a gap 138 therebetween. In this manner, the main cam 66 cooperates with the respective locking cams 64 to urge the pawls 62 into the locked position, as will be described further below.

[0036] The main cam 66 further includes a pair of posts 140 extending from the respective first and second arms 108, 110, as best shown in FIGS. 2A AND 2B. The posts 140 are adapted to engage a release cam 142 to fix the release cam 142 to the main cam 66 for rotation therewith.

[0037] The release cam 142 is a substantially flat member having a central attachment aperture 144, a first cam aperture 146, a second cam aperture 148, and a pair of attachment apertures 150. The central aperture 144 is rotatably received by cylindrical section 120 of the main pivot 116 such that the release cam 142 freely rotates relative to the inner and outer housing plates 18, 20. The first cam aperture 146 includes a cam surface 152 operable to engage the reaction surface 88 of pin 86 while the second cam aperture 148 similarly includes a cam surface 154 operable to engage reaction surface 88 of pin 86, as bests shown in FIG. 3. The attachment apertures 150 fixedly receive posts 140 of the main cam 66 such that as the main cam 66 rotates, the release cam 142 will rotate therewith. In operation, rotation of the main cam 66 causes concurrent rotation of the release cam 142, thereby causing the pin 86 to travel along the respective cam surfaces 152, 154. Such movement of the respective pins 86 causes the pawls 62 to disengage the sector plate 14 and permit rotation of the sector plate 14 relative to the inner and outer housing plates 18, 20, as will be described further below.

[0038] The main cam 66 biases the pawls 62 into the locked position via locking cams 64 due to the interaction of the main pivot 116 and a coil spring 156. The coil spring 156 is disposed on an outer surface of the inner plate 18 and includes a central flat 158 and an outwardly extending arm 160. The central flat 158 is matingly received by the spring seat 126 of the main pivot 116 while the arm 160 engages a spring post 162, as best shown in FIG. 1. The spring post 162 is fixedly received by spring aperture 32 of the inner housing plate 18

and serves to fix the position of arm 160 relative to the inner housing plate 18. In this manner, the coil spring 156 biases the main pivot 116 in the counterclockwise direction (CCW) relative to the view shown in FIG. 4, thereby causing the main cam 66 to position the locking cams 64 and pawls 62 in the locked position.

[0039] With particular reference to FIGS. 3-8, the operation of the recliner mechanism 10 will be described in detail. In a first operational mode, a force is applied to the main pivot 116 to rotate the main pivot 116 against the bias of the coil spring 156. Such rotation of the main pivot causes the main cam 66 to rotate, thereby causing engagement surfaces 128, 134 of the main cam 66 to disengage reaction surface 104 of the locking cams 64. Once the reaction surfaces 128, 134 have released the locking cams 64, the locking cams 64 are permitted to rotate relative to the inner and outer housing plates 18, 20, as best shown in FIGS. 6 and 7. As can be appreciated, once the engagement surfaces 128, 134 are released from engagement with the locking cams 64, the pawls 62 are free to travel along posts 94 relative to the inner and outer housing plates 18, 20 due to the interaction between the posts 86 and the release cam 142.

[0040] Rotation of the release cam 142 caused by rotation of the main cam 66 causes pins 86 to travel along the respective cam surfaces 152, 154 of the cam apertures 146, 148. Upon sufficient rotation of the release cam 142, the pins 86 will encounter a raised portion 164 formed on said cam surfaces 152, 154, thereby causing the pawls 62 to translate relative to the inner and outer housing plates 18, 20. More particularly, as the pins 86 move along the cam

surfaces 152, 154, the pawls 62 are caused to move concurrently therewith along the posts 94 due to the pins 86 being fixedly attached to the respective pawls 62, as previously discussed. Translation of the pawls 62 is permitted as engagement surfaces 128, 134 have released the locking cams 64, as best shown in FIGS. 6 and 7.

[0041] The shape of the cam surfaces 152, 154 are designed such that the pins 86 will not encounter the raised portion 164 until the main pivot 116 has sufficiently rotated and the reaction surfaces 128, 134 from engagement with the locking cams 64. As can be appreciated, if the pins 86 encounter the raised portions 164 of the respective cam surfaces 152, 154 before the locking cams 64 have been released from the engagement surfaces 128, 134, the pawls 62 would not be permitted to translate relative to the inner and outer housing plates 18, 20 and the recliner mechanism 10 may bind.

[0042] Once the pins 86 have sufficiently translated the pawls 62 relative to the inner and outer housing plates 20, the teeth 72 of the pawls 62 will disengage the teeth 58 of the sector plate 14, thereby permitting the sector plate 14 to rotate relative to the inner and outer housing plates 18, 20. At this point, the recliner mechanism 10 is in the unlocked position.

[0043] To return the recliner mechanism 10 to the locked condition, the force is released from the main pivot 116 such that the coil spring 156 is permitted to once again bias the maim pivot 116. The coil spring 156 will bias the main pivot 116 and rotate the main cam 66 and release cam 142 into the locked position. Specifically, sufficient rotation of the main cam 66 will cause

engagement surfaces 128, 134 to contact the locking cam 64, thereby rotating the locking cams 64 about pivots 22. Such rotation of the locking cams 64 causes reaction surface 102 to apply a primary force X to the pawls 64, thereby causing the pawls 64 to translate relative to the inner and outer housing plates 18, 20.

[0044] The pawls 62 are permitted to translate due to the shape of the respective cam apertures 146, 148. Specifically, as the main cam 66 is rotated due to the bias of spring 156, the pins 86 travel along the cam surfaces 152, 154 generally away from the raised portion 164. Once the pins 86 move from engagement with the raised surface 164, the pawls 62 are free to be translated relative to the inner and outer housing plates 18, 20 due to the primary force X exerted thereon by locking cams 64, as best shown in FIG. 5. Upon sufficient translation, the teeth 72 of the pawls 62 will again engage the teeth 58 of the sector plate 14, thereby returning the recliner mechanism 10 to the locked position.

[0045] The recliner mechanism 10 is held in the locked position due the interaction between the main cam 66, locking cams 64, and pawls 62, as previously discussed. The rotational force imparted on the main cam 66 due to the coil spring 156, causes the engagement surfaces 128, 134 to contact the reaction surface 104 of the respective locking cams 64, thereby causing the locking cams 64 to rotate about rivets 22 and engage the pawls 62. More particularly, the reaction surfaces 102 engage the reaction surface 76 of the respective pawls 62 and apply the primary force X thereon. Due to the angular

relationship between reaction surface 76 and the locking cam 64, the primary force X is applied at an angle Θ relative to the pawls 62, whereby Θ is substantially between 14-22°, as previously discussed.

[0046] The primary force X comprises resultant forces Y and Z due to the angular relationship between reaction surface 76 and locking cams 64, as best shown in FIG. 5. Resultant force Y imparts a force on the pawls 62 generally normal to the teeth 58, 72 and serves to hold the pawls 62 in contact with the teeth 58 of the sector plate 14. Resultant force Z applies a force generally in the direction of rotation of the sector plate 14 and serves to maintain the teeth 58 of the sector plate 14 in engagement with the teeth 72 of the pawls 62. In this manner, the resultant forces Y, Z restrict movement between the teeth 58 of the sector plate 14 and the teeth 72 of the pawls 62 such that even small variations between the teeth 58, 72 are prevented from causing a slip or rattle condition during use.

[0047] The angular relationship between reaction surface 102 of the locking cams 64 and the reactor surface 76 of the pawls 62 allows the sector plate 14 to be securely held in the locked position when the pawls 62 are engaged with the sector plate 14. In addition, such an angular relationship (i.e. where Θ is substantially between 14-22°) reduces the force required to overcome the interaction between the locking cams 64 and the pawls 62. In other words, the angular relationship ensures that the main cam 66, locking cams 64, and pawls 62 will sufficiently lock the sector plate 14 relative to the inner and outer housing plates 18, 20 while concurrently optimizing the force required to release

the pawls 62 from engagement with the sector plate 14 and permit rotation of the sector plate 14 relative to the inner and outer housing plates 18, 20.

[0048] With respect to FIG. 8, a seat assembly 166 is shown incorporating the recliner mechanism 10 of the present invention. The seat assembly 166 includes a seat back 168, a seat bottom 170, and an actuation handle 172. The seat back 168 is pivotably supported by the seat bottom 170 having the recliner mechanism 10 disposed therebetween. The actuation handle 172 is fixedly attached to the main pivot 116 such that a rotational force applied to the actuation handle 172 is transmitted to the main pivot 116.

[0049] In one embodiment, the sector plate 14 is fixedly attached to the seat back 168 and the outer housing plate 20 is fixedly attached to the seat bottom 170 such that rotation of the sector plate 14 relative to the outer housing plate 20 causes concurrent rotation of the seat back 168 relative to the seat bottom 170. Alternatively, the sector plate 14 could be fixedly attached to the seat bottom 168 and the outer housing plate 20 fixedly attached to the seat back 168 such that rotation of the outer housing plate 20 relative to the sector plate 14 causes concurrent rotation of the seat back 168 relative to the seat bottom 170.

[0050] In either configuration, a force is applied to the actuation handle 172 to rotate the main pivot 116 against the bias of coil spring 156. As previously discussed, such rotation will cause the main cam 66 to rotate and release the pawls 62 from engagement with the sector plate 14. Once the pawls 62 are released, a force may be applied to rotate the seat back 168 relative to the seat bottom 170. Once the desired position for the seat back 168 is achieved, the

actuation handle 172 is released, and the pawls 62 will re-engage the sector plate 14, thereby locking the seat back 168 in the desired position relative to the seat bottom 170.

[0051] As previously discussed, the main cam 66, locking cam 64, and pawls 62 serve to lock the sector plate 14 to the outer housing plate 20. However, if a sufficient force is applied to the seat back 168, the pawls 62 are further held in the locked position by the interaction between reaction surfaces 130, 136 and the pawls 62. More particularly, if the recliner mechanism 10 experiences a sufficient load, the reaction surfaces 130, 136 will close the gaps 132, 138 between the second arm 70 of the pawls 62 and the main cam 66 until the reaction surfaces 130, 136 engage the reaction surfaces 80 of the pawls 62. In this manner, the main cam 66 further ensures engagement between the pawls 62 and the sector plate 14, thereby maintaining the recliner mechanism 10 in the locked position.

[0052] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.